# O C O N E E  N U C L E A R  S T A T I O N

## EVALUATION OF POTENTIAL FOR TURBINE BUILDING FLOODING

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## 1.0 INTRODUCTION

On October 13, 1976, the Duke Power Company Design Engineering Department was directed to conduct a review of any potential sources of flooding of the Oconee Nuclear Station Turbine Building, and if should occur, to provide methods for additional assurance that critical equipment in the Turbine Building and/or Auxiliary Building are adequately protected. An organization was formed which represented the Civil/Environmental, Electrical, and Mechanical/Nuclear Divisions under the direction of the Chief Civil Engineer. This report details those actions which are considered necessary to mitigate the consequences of a potential Turbine Building flood. It should be noted that detailed design work has not been completed. The description presented herein is conceptual; however, calculations have been performed to verify the capability of this system.

## 2.0 OBJECTIVE

This study has been performed to focus exclusively on the issue of the operability of critical equipment which is required for safe control of the reactors to safeguard the public health and safety in the event of a Turbine Building flooding situation.

## 3.0 DESIGN BASIS TURBINE BUILDING FLOOD

The Oconee Nuclear Station FSAR Supplement 13 has addressed the concern of Turbine Building flooding. In that analysis, the failure of a rubber expansion joint spanning a 4½" physical gap in the 78" condenser circulating water intake pipe was considered. In the incident which occurred on October 9, 1976, the flooding rate was considerably less than that assumed in the analysis. However, for the purposes of this study, a hypothetical Turbine Building flood was assumed which would result in a flow rate of approximately 1,000 cfs into the Turbine Building. The specific cause of the hypothetical Turbine Building flood has not been postulated, it was selected as an upper bound. Hypothetical flooding scenerios related to water hammer overpressure, failure of expansion joints or a condenser water box, and inadvertent opening of waterbox and pipe manways are all events of lesser magnitude than the assumed design basis Turbine Building flood.

It was assumed that the pneumatic condenser cooling water discharge valves were inoperable and the cooling water pipe crossover valves were open during the flood. The flood does not occur simultaneously with nor subsequent to any other accident condition.

## 4.0 RESULTS

Numerous schemes were considered to mitigate the consequences of a hypothetical Turbine Building flooding event. The scheme chosen relies on a large drain installed on the south end of the Turbine Building which would limit flood water elevation to a level such that the emergency feedwater pumps and three low pressure service water pumps could be protected. This would enable control of the reactor through existing systems using existing procedural techniques.

4.1 Major Functional Components

a. Turbine Building Drain

An opening approximately 5 x 45 feet will be placed in the south end of the Turbine Building basement wall. Water would discharge through this hole on to a spillway section and into 200' long x 10' diameter pipe. The water would then be directed by a ditch to the Keowee tailrace area.

b. Walls Around the Three Emergency Feedwater Pumps

Waterproof walls would be constructed around the emergency feedwater pumps to a height above the maximum flood elevation. Access would be provided from above. Appropriate modifications to existing piping, auxiliary equipment as well as installation of sump pumps would be accomplished.

c. Turbine Building/Auxiliary Building Wall

The wall separating the Turbine Building and Auxiliary Buildings will be waterproofed and sealed to a height above the maximum flood elevation. Structurally the wall is capable of handling this hydrostatic load.

d. Low Pressure Service Water Pump Walls

Three low pressure service water pumps will be protected by waterproof walls to a height above the maximum flood elevation. Only two pumps are required to supply all three Oconee units.

4.3 Operation During the Design Basis Flood

The source of the design basis flood is assumed to be the northernmost Unit 1 main condenser. The water must flow from Unit 1 to the drain in the south end of the Turbine Building. A back water curve was computed to determine the maximum water depth required to drive the flood through the Turbine Building and the drain. The Auxiliary Building is protected by the water-tight Turbine/Auxiliary Building wall and the three emergency feedwater pumps are protected by their individual waterproof walls. A supply line for the emergency feedwater pumps will be installed to the condenser circulating water pipe to insure an indefinite supply of feedwater. The reactor will be maintained in a condition of hot shutdown or below by allowing steam to escape from the main steam relief valves and makeup water to be supplied to the steam generator from the emergency feedwater pumps. The reactors can be brought to or maintained in a cold shutdown condition since the low pressure injection pumps and low pressure service water pumps will be protected.

There is no immediate need to trip the CCW pumps nor is there a need to prevent lake water from entering the Turbine Building through the discharge or intake pipes since it is simply routed through and out of the Turbine Building. The flood would be terminated by lowering Lake Keowee to elevation 791. This would require approximately 18.3 hours by utilizing the Keowee spillway, hydro units and discharging through the Turbine Building. Lowering Lake Keowee to elevation 791' will not affect the stored energy or ultimate heat sink for Oconee Nuclear Station.

## 5.0 ADVANTAGES OF THIS APPROACH

The advantages of the Turbine Building drain scheme are numerous in comparison with any other proposed alternatives. Some of these advantages are: The Turbine Building flood scheme is a passive device for controlling flood water elevation in the Turbine Building; the reactors are maintained in a hot shutdown condition or may be placed in cold shutdown for which demonstrated approved procedures already exist; installation of the Turbine Building drain can be accomplished without major impact on station operation; pump out of the Turbine Building following an event would not be a consideration; and the relative simplicity of this scheme is desirable.

## 6.0 SCHEDULE

Preliminary design work has been completed and is described in this report. Final design work is currently in progress. Construction is scheduled to begin August 1, 1977. Final implementation of the proposed modification is scheduled for approximately December 15, 1977.

## 7.0 CORRECTIVE ACTIONS

Various corrective actions were proposed in Reportable Occurrence Report RO-287/76-18 to prevent future recurrence of that incident. Due to the design of this proposed method to control Turbine Building flooding, a reassessment of those corrective actions was conducted. Unless stated otherwise, these actions will be completed by December 15, 1977.

1. The present pilot solenoids on the condenser discharge valves will be replaced with dual coil mechanically latched types.

2. The power source for CCW controls will be changed to an ICS power panelboard.

3. Position indicating lights will be added in the control room for the condenser discharge valves. This item will not be performed since it is no longer necessary.

4. The local control stations for the condenser valves will be relocated to the mezzanine level.

5. The physical layout of electrical cabling and pneumatic tubing in the vicinity of the condensers will be reviewed to insure adequate protection from damage by water force.

6. A review will be conducted to determine the feasibility of raising the instrumentation, lube oil pump, and cooling water pump for the emergency feedwater pump. - Completed, these pumps and auxiliaries will be protected.

7. The procedures for opening the CCW system inside the Turbine Building will be reviewed and revised as necessary. - Completed

8. A design review of the station for susceptibility of similar type flooding incidents will be conducted. - Completed